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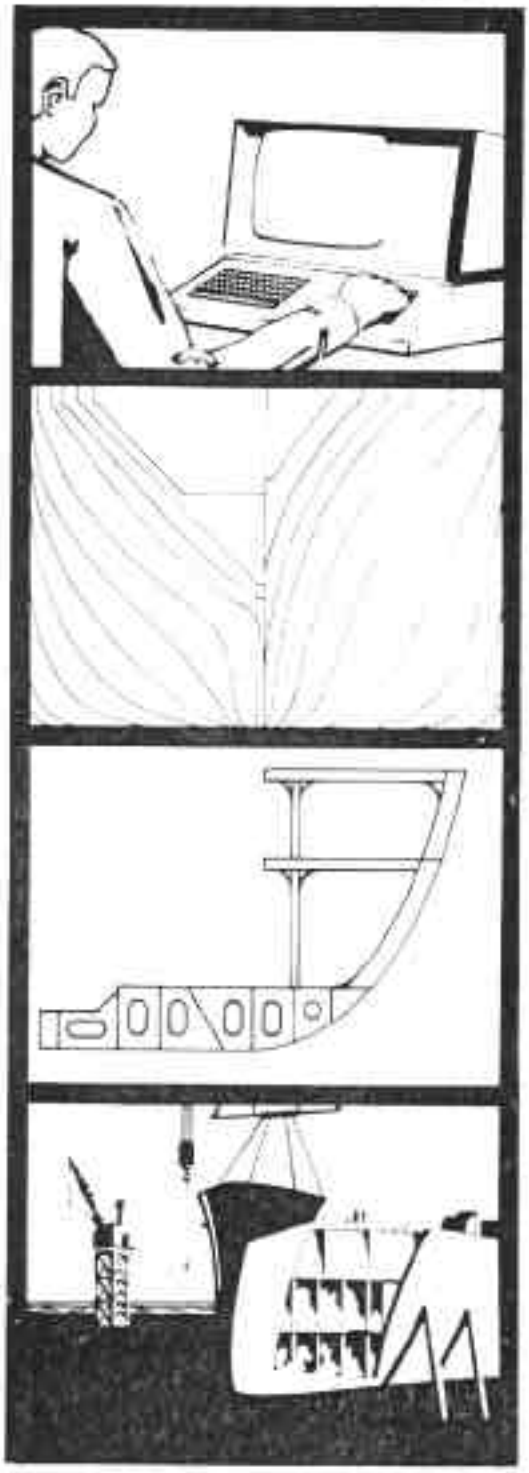

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INCREASED SHIPBUILDING PRODUCTIVITY THROUGH PRODUCTION ENGINEERING

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GOOD MORNING:

I was especially pleased to accept the offer to speak on this subject having devoted my career as a shipbuilder and now as a consultant to productivity problems.

Before I discuss the details of how production engineering can help a shipyard, I thought it may be worthwhile to review the present state of American Shipbuilding:

First, we have the "Big Soys": These are the shipyards who build commercial and government large ocean-going vessels. All but one are part of a conglomerate. Over the past 10 to 20 years they have modernized their shipyards, introduced computerized lofting and NC burning, along with a sophisticated production planning and control system. Production Engineering can help these shipyards but the degree of improvement is limited. The fate of the "Big Soys" lies in the hands of the Government. Government policy for private shipbuilding and for the US Navy will determine how many of these shipyards will survive or close. The amount of diversification will be a major element as to who will survive or who will fall.

Next, we have the offshore petroleum and gas industry. If our country is to survive this has to be a growing industry. My experience is this field is limited and therefore, I will not comment on its future except to say it looks good.

The third area, and the one which I have had the most intimate contact with during the last five years, is the Inland Water Ways, Coastal and the Great Lakes Shipbuilders. The latest MarAd study

predicts waterways cargo will double by year 2000. The number of hopper, tank, deck and other types of barges presently operating on American rivers and coasts exceed 20,000. The expected life of these barges is around 20 years. Therefore, you can equate the numbers to a potential need of around 1500 barges in 1980, and growing to a potential need of 3000 barges per year by the year 2000. Supporting tow boat construction and repair services will also be required.

Looking at the "numbers" I think it is safe to say that this area of shipbuilding can look forward to some very good years.

Major productivity improvement potential exists in the following shipyard areas:

1. Organization (People and Structure)
2. Engineering
3. Planning and Production Control
4. Material Handling and Control
5. Production Engineering

The first four items are necessary prerequisites for a productive shipyard operation.

ORGANIZATION

Good people are the most important element of any organization. They benefit and are able to operate more efficiently when the organizational structure is clearly defined as to functional responsibilities and duties. A good management information system also improves the overall effectiveness of these good people.

The trained shipyard worker has become harder to hire and retain. This trend is expected to continue, therefore better training and retention

programs must be developed. The threat of losing skilled workers to construction and other higher paying Industries will continue. The answer is to increase productivity and develop equipment, systems, procedures and methods that reduce the man-hours required to build ships.

ENGINEERING

The key to a successful start of a shipbuilding contract is how well the Engineering department performs. If Engineering can issue complete approved plans and material requisitions on schedule the first hurdle is passed. However many times Engineering is not allowed enough time in the schedule and the result is that preliminary plans or incomplete plans are released to the yard. Many yards make the mistake of working to these preliminary or incomplete plans in the hope that when the "clean" plan is issued they will have minimum rework which is usually not the case. The result of this action is that:

a) Production man-hours used for installation and then ripout results in no physical progress.

b) Material costs have increased

C) All paperwork had to be redone and reissued

d) Work is more delinquent to schedule than if it was not performed.

e) Supervision and worker morale suffer.

With the present great need for trained shipyard workers the best course of action has to be not to work an area where the plans are not "clean" and for management to expedite resolution of problem areas.

Shipyards that have their own Engineering departments have the advantage of better control of their destiny than those that have to

use a design agent and computerized lofting services. Greater engineering lead time is required and changes have a greater schedule impact when using design agents. In addition the design agent usually is not aware of shipyard equipment, production 'methods and operating procedures.

My experience has shown reductions of over 25% in production man-hours as a result of a detail production engineering review of engineering drawings and improvements in production methods and operating procedures. Not only do you get the benefits of reduced man-hours but you can improve your performance to schedules. This area will be discussed later in more detail.

PLANNING AND PRODUCTION CONTROL

We have conducted many surveys in shipyards that are involved in this industry and have found that the Planning and Production Control system (PPC) used in these shipyards vary greatly. Reference (A) is an excellent text on production oriented planning. In general, except for the major shipyards much can be done to improve the PPC systems; it would be very cost effective if shipyards had an objective outsider like Shipbuilding Consultants Inc. (SCI) review their PPC operations to determine its effectiveness.

MATERIALS HANDLING AND CONTROL

To maintain productivity, materials must be at the job site on time and located within easy reach of the worker. Complete work must be moved to its next destination quickly to minimize delays or relocation of workers. An effective material handling and control system adds greatly to improve productivity.

PRODUCTION ENGINEERING

The remainder of this speech will. be devoted to production engineering. I am convinced that if a shipyard is operating with good people and has good control over Engineering, Planning and Production Control and Materials, it will be a successful shipyard. However, the following is a more common situation:

It is customary for the shipyard before contract award to establish various schedules which indicate the dates by which they plan to accomplish the various requirements leading to delivery of the vessel by or before contract date. All too often, based on the shipyard's "need" for the contract, the schedule is what I term "forced". One or more of the schedule events cannot be accomplished to meet the schedule presented to the owner. Either engineering, materials or production, or all three functions are being "forced" by top management to meet these schedules when in fact they don't know how they will accomplish their responsibilities.

Shipyard management should "test" all schedules before committing to an owner. The "test" should be an objective in depth review of the shipyard's resources as they pertain to meeting existing and pending contract requirements including factoring into the review other requirements or possibilities that may affect performance. Specific items that should be inlcuded in this review are:

a) Engineering resources to meet scheduled approval plan issue dates. (not preliminary releases)

b) Engineering resources to meet purchase specification and material requisition schedule dates.

c) Engineering resources to handle changes and shipyard, liaison problems.

d) Material long lead items delivery to support in yard schedule dates.

e) Production manning resources by department to meet all, in-house contract requirements.

f) Production performance evaluation which may change number of men required by specific trades to meet all contract require;, ments.

g) Evaluation of labor contracts including major equipment suppliers as to possible impact.

h) Facilities review of equipment, lay down space, lifting requirements, throughput, maintenance and possible breakdown of, required equipment, etc.

j) Other items not limited to potential weather conditions (cold, flood, etc.) turnover, training, labor pool, local politics and industry trends.

Upon completion of this objective review, top management will have a listing of the "hard spots" which can effect meeting contract requirements. The problems will have been identified and a corrective action plan can then be developed to ensure solving of the problems and meeting cost and delivery requirements.

The necessary corrective action can be attained through production engineering to reduce man-hours and costs and reduce schedule times to meet contract deliveries.

I'm sure that you all have a multitude of opinions as to the definition of production engineering. Mine is a "catch all" definition:

Production Engineering is:

Any effort applied to existing operations, methods, and procedures that results in a reduction in man-hours, material savings or improved schedules.

I have found that the best approach to take in conducting a production engineering survey in a ship,yard to attain the fastest gains in productivity and be least expensive is as follows:

1) Conduct an in-depth review of all functional departments to determine how they operate and support the manufacturing process leading to delivery of the product.
2) Identify the critical path schedule and magnitude of man-hours and cost expenditures relating to schedule key events.
3) Conduct a production engineering analysis of 1 and‘2 to identify areas for improvement.
4) Formulate recommendations and prepare justifications and estimate of results to obtain approval of recommendations.
5) Implement recommendations through in-house personnel and follow up on progress.

Let me give some representative examples of what we have found during our various surveys:

Critical Path

The critical path in ship, boat, or barge construction usually is from keel to launch and for self-propelled vessels also from launch to delivery. The total elapsed time and degree of manning applied usually determines how performance will be to budget.

Anything that can be done to shorten the elapsed time has a greater effect than just that of the specific item savings. This is because approximately 20 to 30% of the man-hours being expended during these periods are time related i.e.: supervision, crane operators, cleaners, temporary services, security, material men etc. If the one specific item reduced the schedule by one week you would also get a one week reduction in all time related charges.

Production engineering items that we have implemented with great success in shortening the critical path are:

1) Planning and scheduling work upstream and/or in parallel to remove it from the critical path.
2) Erection of larger hull sections
3) Utilizing better jigs and fixtures
4) Improved manning and manpower assignments
5) More automative welding equipment or better processes.
6) Preoutfitting

Steel Subassembly and Main Assembly

Steel Subassembly and Main Assembly work also requires long elapsed schedule time and many production man-hours. The facility required to efficiently perform this type of work usually consists of covered high bay buildings with heavy lift capabilities. Many yards, however, are forced to perform this work outside. The common error made is in the type of work that is performed in these work areas. All to often you will see such items as layout, fitting, tacking and welding of stiffeners and brackets to plates or panels and also stiffeners being put on webs.

The time required to perform this type of work ties up these valuable facilities. It also requires that you have more floor space than is necessary or forces work outdoors. This type of work does not require high bays with heavy lift capability and therefore should be scheduled to be performed elsewhere.

The following items will improve productivity of the transferred work:

1. Numerical control burning and marking
2. Plate stiffening
3. Webb stiffening
4. Panel stiffening
5. One sided welding up through 5/8" thickness
6. Magnetic bed and welding gantries
7. Special jigs and fixtures
8. Shape line

Production engineering evaluations and justifications Will be required for all of the above items.

Other Areas

There are many other areas where production engineering can increase productivity. Starting in engineering a complete review of the design for changes that will help production is always advisable such items as:

1. Restraking for plate stiffening
2. Part numbering
3. Part standardization
4. Modular breakdowns
5. Access
6. Staging

In Production, operating procedures and work methods should be reviewed and improved. Evaluations of covered vs. open work areas sometimes reveals areas of improvements. Organization of work areas to improve the production flow and doing as much outfitting on land rather than in the water will prove to be very beneficial.

This can go on and on, however I believe that I have given you a good idea as to the activities that can be affected by production engineering. Ideally people in this area should be shipbuilders with experience in several yards with an industrial engineer or equivalent background. Properly motivated and utilized, personnel in this activity I can say with considerable experience will in every shipyard increase productivity through improved methods, procedures and operating systems. This, coupled with an efficient PPC system, a good material handling and control system, good sound practical' engineering and an efficient organizational structure then the shipyard is ready for the "icing on the cake."

Work Measurement

I am happy to see that five of our major shipyards are participating in a MarAd funded program to establish standards for many of the shipyard production trades. At Bath Iron Works Corporation we participated in establishing engineering standards for use in steel fabrication shop scheduling and loading, the pilot program that led to present efforts. I quote from Reference (A), "Before engineered standards were used the completion of units averaged 3.2 weeks late. For the three month period in which engineered standards were used the averaged time was reduced to zero weeks and a reduction of 21% in man-hours-per-ton beyond normal learning effects was projected."

These improvements I feel were attained more from detail scheduling of the work areas and improvement in operating methods and procedures than from establishing standards. I have visited many shipyards and observed their production operations and truly feel that most american shipyards are not ready for detail standards. Standards should be developed based on the best methods and procedures. In most yards much can be done to improve the production methods and procedures.

We are putting the "cart before the horse" The improvements that can be made through production engineering in the areas I have discussed today far outweigh those that will result from work measurement, time studies and standards. The best answer for a shipyard is to reduce man-hours and schedule span times by initiating a detailed production engineering survey of existing operations. My company's brochure is up front here describing the services we offer in these areas. I will be pleased to answer any questions and I, Thank You.

REFERENCES

Ref. (A) A Manual On Planning and Production Control for Shipyard Use. MarAd and Bath Iron Works Corp.